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SCIENCE WORK

IN RUGBY SCHOOL

RUGBY: W. BILLINGTON

1870

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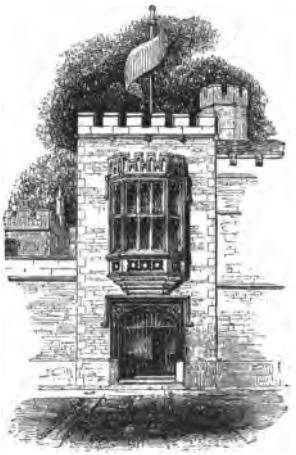
SCIENCE WORK

IN RUGBY SCHOOL



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In September, 1866, Mr. Farrar, of Harrow, read a paper before the British Association on the subject of Natural Science teaching in Public Schools, to which my friend and colleague, Mr. Wilson, contributed a sketch of what we were doing at Rugby. This was printed separately, and has been found very useful to parents of Rugby boys, as well as to others interested in education.

Since that time, however, important changes have been made in our work which has undergone extension and modification in various ways.

I have therefore, at the request of others, drawn up the following brief account of our arrangements for the systematic teaching of Natural Science as they are at present carried out.

In two or three places I have quoted *verbatim* from Mr. Wilson's paper, and in the closing paragraphs I have gladly availed myself of his remarks on the results of the more extended teaching of Science in our School.

T. N. Hutchinson.

SCIENCE WORK IN RUGBY SCHOOL.

NATURAL PHILOSOPHY was first introduced into Rugby as a subject of School instruction by Dr. Tait in 1849. The lecturer was a resident physician in the town, an F.R.S. His lectures, which included Chemistry and Physics, were delivered in the Town Hall and attendance was voluntary. Dr. Goulburn afterwards appointed successively two of the Classical Masters who had strong scientific tastes to carry on the instruction in Natural Philosophy. After Dr. Temple became Headmaster the Natural Science work was undertaken by one of the Mathematical Masters, and in 1859 the Trustees added a lecture room and Laboratory to the School buildings, thus giving considerable impulse to the new studies. Soon after this another Mathematical Master took part in the Natural Science teaching, and Botany was added to the subjects of instruction, in addition to Chemistry, Geology and Physics. During this time, however, Natural Science was only taught as an alternative subject. A boy

private Laboratory for the Chemical lecturer, a Chemical lecture theatre with raised seats for 50, a similar but still larger theatre for Physical Science and Geology, and an apparatus room with means and appliances for instrumental work of various kinds.

The regular subjects of instruction have hitherto been Botany, Physical Geography and Astronomy, Geology, Mechanics and Mechanism, Chemistry, and Electricity, including Magnetism. Heat, Hydrostatics, and Pneumatics have also occasionally been taken in lieu of other subjects. The boys are divided into 'sets', each set having two lectures a week. The lectures are strictly catechetical, and are fully illustrated by plants, diagrams, specimens, models, and experiments, as the case may be; the duration of each lecture varies from three-quarters of an hour to an hour. In addition to attendance at the two weekly lectures the boys are expected either to shew up note-books from time to time, which have been elaborated from rough notes taken in the room, or to make abstracts, or work examples, so as in every case to give evidence of having intelligently followed the lecturer. Examinations are also held from time to time, and the results are embodied in the monthly characters sent to the parents.

The subject that has been found on the whole to answer best for a commencement is Botany. It needs no special preparatory studies and it serves as an excellent introduction to scientific terminology and classification; while the patience, care, and accuracy of observation required in examining and comparing the

different parts of plants cannot but prove of real value in the intellectual training of boys.

The introduction of Elementary Astronomy has been rather a matter of convenience to suit our School arrangements. The scholastic year begins in September, when two new Botany 'sets' commence. A certain number of new boys, however, enter the School in January; and as it is impossible to begin the subject over again at that time, the new boys in the Middle School form a supplementary set, taking up selected portions of Astronomy to last two terms. These boys then go to Botany in the following September.

The new boys in the Middle School at Easter form a set by themselves for commencing Botany, and go on with the subject as an advanced set in September. The class-book used by the Botanical lecturers is Oliver's 'Lessons,' but the system followed in teaching is a modification of that employed by Le Maout in his fine work, "Leçons Elémentaires de Botanique." In Astronomy Mr. Norman Lockyer's little book has been used. In no case, however, does a teacher confine himself to a single text-book. In Geology "the lectures include the easier parts of Lyell's 'Principles,' *i.e.* the causes of change now in operation on the earth; next, an account of the phenomena observable in the crust of the earth; stratification and its disturbances and the construction of maps and sections: and, lastly, the history of the stratified rocks and of life on the earth." The lectures are illustrated by a very fair School Museum, many of the specimens in which have been obtained

by the boys themselves, and also by a capital collection of diagrams and drawings exhibiting geological phenomena. The subject is one that has been found to interest a large number of boys, and the local Geology has been well and vigorously worked out by past and present members of the geological sets. In Mechanics there have hitherto been two sets, one elementary and the other more advanced, each lasting a year. The subjects included in the easier course are, the so-called Mechanical powers with their various practical applications, the centre of gravity and different kinds of equilibrium, and the composition and resolution of forces. Models and diagrams are extensively employed, and the boys are required to work a considerable number of numerical examples and to take full notes of each lecture, as no special text-book is used.* In the higher set the lectures comprise

1st. The equilibrium of structures and framework, theory of girders, arches, roofs, tubular bridges, buttresses, &c., and here again the boys are taught practically to work out the tensions and thrusts of the different parts in a given roof or piece of frame work, to find the breaking weight of beams of various kinds, &c.

2dly. The elements of Mechanism, conversion of one kind of motion into another, cams, wheel work, parallel motions, &c., the different arrangements

* I quite expect to use Dr. Balfour Stewart's Lessons in Physics as a text-book as soon as the work is published.

being illustrated as far as possible by actual working models.

3dly. The history, theory, and mechanism of the steam engine.

The chief difficulty in teaching Mechanics satisfactorily has arisen from the ignorance of many boys in Arithmetic and Geometry. Simple as is the amount of such knowledge required to work examples in Mechanics, it is yet beyond that of a large number of boys who enter a Public School. It is proposed in future not to allow any boy to join a Mechanical set who has not reached a certain stage in the Mathematical work of the School.

The remaining subjects of Chemistry, Electricity and Heat are not taught in lectures except to boys in the Sixth Form and Upper School. Chemistry and Electricity have hitherto been taken in alternate years, each occupying three terms. In future, however, this will not be the case, and each boy in the Sixth or Upper School will be able to go through the three subjects of Chemistry, Electricity and Heat in successive yearly courses.

After some years' experience the Chemical teaching, so far as *lectures* are concerned, has been confined to the non-metallic elements. As a rule, the Chemistry of the metals does not present the same variety that is found in the study of the other elementary bodies, and there is too much apparent sameness in the preparation and properties of the different metallic salts to interest

any but those who have a decided taste for Chemistry. Roscoe's text-book is adopted and a large number of experiments are performed before the boys. At every 5th or 6th lesson a paper of questions is given on the subjects that have last occupied the attention of the class, and from the results of these papers the marks and order for the term are obtained.

In Electricity and Heat Ganot's Physics has been selected, and here again abundant experimental illustration is combined with written answers to questions and the working of numerical examples.

Till the new Laboratory was erected it was only possible to allow of a small number of boys studying Practical Chemistry. Such boys as shewed a special aptitude for Chemistry might, with their parents' permission, become private pupils of the Chemical lecturer and work at Analysis with him in the small School Laboratory. Since the large Laboratory has been finished, however, the number of boys who have availed themselves of it has been between 30 and 40 in each term, and instead of being only open to private pupils, there will now always be, in addition to these, a practical Laboratory 'set,' composed of picked boys who have shewn special industry and intelligence in their previous Natural Science work. In this way the Laboratory will act as a stimulus and a reward to those who are really in earnest in their work. Each Laboratory pupil has two lessons in the week of about an hour and a half's duration. The books used are 'Harcourt and Madan's Practical Chemistry' for beginners, and

'Fresenius' for those more advanced. The boys commence with the preparation of the commoner gases and chemical substances so as to become practically acquainted with their properties and the ordinary methods of manipulation. They then go on with the examination of the characteristic properties of the metals and acid radicles, and so to the application of these properties in the work of actual analysis.

The Laboratory instruction is given by the senior Natural Science Master, who is also the Chemical lecturer, and his assistant. The regular Laboratory 'set' comes at stated hours, twice a week, the boys mostly working in pairs. The other pupils are allowed to choose such times as fall in best with their other work, and the result is that there are few hours in the day when there is not some one working in the Laboratory. This plan has the advantage of preventing the room being over-crowded, and the boys get more individual attention from their teachers.

In brief, then, the arrangement of the Natural Science work is this.

In September the new boys in the Middle School begin Botany in two sets under different lecturers. A third Botanical set consists of those who entered the School the previous Easter. These three sets continue separate during the October and Lent terms; but after Easter the three are arranged according to proficiency and merged into two sets for the last term's work, and a commencing Botany set is formed consisting of the new boys.

Two sets commence Geology, also under different masters, consisting chiefly of those who have done Botany. These two sets are combined into one after Christmas, so as to allow one of the lecturers to take the new boys in January as an Astronomy set, which is continued through two terms.

Those who have done Botany and Geology form an elementary Mechanical set, and those who have been through the elementary course form an advanced set for Mechanics and Mechanism, &c.

Lastly, there is a Laboratory set for Practical Chemistry, formed as already described.

In the Sixth Form and Upper School, which are worked together, four sets are commenced in September, each lasting a year. One in Chemistry for new boys and such as are promoted from the Middle School, one in Electricity for those who have done Chemistry, one in Heat for those who have done both Chemistry and Electricity, and a small advanced Botany set for any who have shewn a special desire to continue that study.

This is the general order of the work, but individual tastes are consulted as far as possible, and any boy having a strong wish to join a particular set has usually little difficulty in doing so. Indeed I believe it to be a matter of real importance to make the system as elastic as possible.

The new boys, of whom we can know but little, are placed in Botanical sets. But during their first year some will probably have shewn that their taste lies

rather in the direction of Physics than Natural History, and in such cases they would be allowed to go on with Mechanics or Physics for the next year instead of Geology, which under ordinary circumstances would follow Botany.

With regard to the encouragements to Natural Science at Rugby I may state

1. That marks are assigned to the Natural Science work in determining the place of each boy at the end of the term, the subject being marked in proportion to the time devoted to it.

2. The subject is included in the examination which the Sixth undergo for exhibitions in July.

3. The order of each set is published in the School "List" at Christmas and Midsummer.

4. Various prizes are given annually, one of three guineas for General Chemistry, and another of equal value for Practical Analysis. Prizes of the value of two guineas each are given for special excellence in Mechanics, Geology, and Botany. The boys are also encouraged to make collections of wild flowers, fossils, or insects, and prizes are given to the most deserving.

One of the results of the Natural Science work at Rugby has been the establishing of a School Natural History Society. The Society has been in existence now for three years and is in a flourishing condition. Meetings are held once a fortnight, when papers are

read and objects of interest in any branch of Natural History are exhibited and explained.

Reports are published annually containing the more important papers and observations of each year. Three reports have already appeared.*

Such, then, has been the nature of our work and experience at Rugby during the last few years.

With regard to the opinion in which that work is held by others most interested in the matter, I cannot do better than quote the words with which Mr. Wilson's paper ends, especially as I have no reason to believe that the opinions therein expressed have been altered since the time when those words were written.

"Lastly, what are the general results of the introduction of scientific teaching in the opinion of the body of Masters? In brief it is this, that the School as a whole is the better for it; and that the scholarship is not worse. The number of boys whose industry and attention is not caught by any School study is markedly less; there is more respect for work and for abilities in the different fields now open to a boy; and though pursued often with great vigour, and sometimes with great success, by boys distinguished in Classics, it is not found to interfere with their proficiency in Classics, nor are there any symptoms of over-work in the School. This is the testimony of Classical Masters by no means specially favourable to Science, who are in a position which enables them to judge. To many who would

* Published by Mr. Billington, Rugby. Price 1s.

have left Rugby with but little knowledge, and little love of knowledge, to show as the results of their two or three years in our Middle School, the introduction of Science into our course has been the greatest possible gain: and others who have left from the Upper part of the School, without hope of distinguishing themselves in Classics or Mathematics, have adopted Science as their study at the Universities. It is believed that no Master in Rugby School would wish to give up Natural Science and recur to the old curriculum."

THE END.

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